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# Portable Interface and Local Service Manager

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**Abstract**

The world demographic projections showed a rise of the elderly population as result of the increase in life expectancy. To check all the possible assistance to the elderly to live this new stage with dignity, autonomy, self-reliance, mobility, security, health and well-being, is a challenge for the Ambient Assisted Living (AAL) technology approach. In this sense, this study attempted to create an Android software to allow disabled and elderly persons to control home devices (lamps, alarm, etc.) and to obtained temperature and other information through speech via an Android Phone.



*Keywords: Ambient Assisted Living; elderly; control; Android Software; home devices;*

## 1. Introduction

Ageing has become a social issue due to the quantitative increase of old persons and is becoming one of the main challenges of the XXI century [1]. Low birth and mortality rates lead to a strong increase of the elderly population especially in developed countries [2]. The concept of ageing population means that the proportion of elderly people is no longer stable (between 5 and 6%) and has progressively increased, exceeding the threshold of 10% [3]. Portuguese population will age consistently in the next decades. Between 2010 and 2050, the total number of people with age over 60 will have increased by more than 40% (more than three million), while the population aged over 75 years will have an addition that will be around 80%. Aging is a fact inherent to human

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beings that can be delayed but cannot be locked [4]. Cognitive abilities may be decreased by physical changes [5] that may lead to a gradual reduction in the sensorial organs, and the balance, vision and hearing are the most affected by age [6]. Demographic changes, associated with the increasing ageing of the population, have the effect of increasing the number of seniors living alone [7]. Ageing is a natural process that requires the ability of the elderly to adapt themselves to environment changes [8]. Advanced technology may improve the quality of life for older and disabled people by making the environment in which they live a comfortable place by changing it into a smart home environment. Obviously, the home environment must be able to satisfy the resident needs. Thus, it has to be modified continuously because the needs of the elderly and the disabled people are always changing [9]. With the increase of life expectancy, the connection between ageing and housing becomes a current issue. Nowadays, especially in European countries where a strong increase of aging population is expected, due to increased life expectancy, smart home technology is increasingly being implemented in new homes [10].

The term, "Ambient Assisted Living" (AAL) is used to describe technologies that help prolong independence for older people in their home environment, as well as the assistance to perform activities of daily living. This technology is based on installing an intelligent home environment that integrates the human living space and interacts with the user. The relevant technologies in the field of AAL application are related to the "home automation" and "ambient intelligence". The Ambient Intelligence follows the goals of computing that have been developed by Mark Weiser [11]. The computer should become invisible to the user. This means that the user must communicate with a smart environment in order to be able to achieve goals through interfaces. The natural interaction is achieved through the support interface for voice, movement and gestures [12]. It should be noted that the sensitivity to the context is also important to support natural interaction and to provide proactive services. In this sense, persons who present physical, sensory or cognitive restrictions can enlist the help of the mobile phone to communicate. They may use the mobile phone for verbal, text or symbol communications and it enables human navigation indoors and outdoors [12].

This work aims to develop a software interface that controls ambient control technologies and services through home networking for better quality of indoor resident's life. The Android smartphone in this work will play a pivotal role in the control of home devices and get temperature and other information.

## 2. Materials

In order to developed the project we used a Smartphone with Android 4.2, equipped with the automatic speech recognizer (ASR) "Google speech" and the Text to Speech (TTS) SVOX® for Android; additional devices are: an Arduino microcontroller with Ethernet connectivity and the module relay Shield of SeeedStudio; two temperature sensors Dallas 1-wire 18B20 in order to measure the evolution of the values of indoor and outdoor temperatures; one led and a Passive infrared sensor (PIR) for alarm purposes, a Lamp and other accessories and a Wi-Fi router.

## 3. Architecture Proposal and Methodology

This paper presents a local home service manager and a mobile unit based user interface on the Android mobile equipped with a Google Speech® ASR, that allows speech recognition and exchanges information with the Software "*Portable Interface and Local Service manager*" (PILSM) in order to perform the required tasks. After interpretation of each user request, it is sent through a router over the Ethernet to the Home Controller (Arduino) and this will execute the requested operation through the relay shield module. The operation confirmation message provided by the Arduino will be voice synthesized by means of the SVOX® TTS for Android software and it can also be read as text on the Smartphone screen. In this application, the screen virtual buttons and the speech will play a key role in this process. The speech will increase the usability and the

intelligibility of the interface, a very important factor for this kind of AAL projects. Fig.1 shows the proposed architecture.

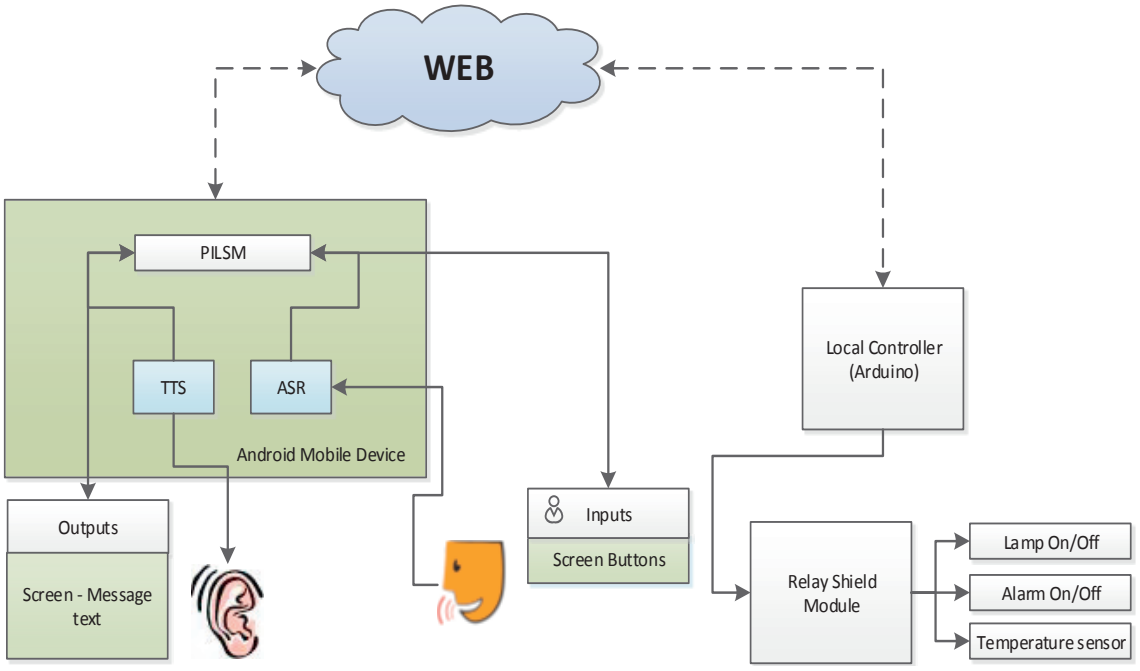


Fig. 1. System Architecture

### *3.1. The Android Software "Portable Interface and Local Service manager"*

The PILSM is a Portuguese software developed by the authors in JAVA® for Android Smartphones and it works as an interface that allows the user to control the environment. Like in an IVR (interactive voice responder) application, this software establishes a dialogue between the user and the environment in order to know what operation the user wants to execute. The first button of the software main menu allows to verify the Web connection. If the Smartphone is connected to the Web a confirmation message is issued through synthesized speech, if not, an error message appears on the screen and the phone will be forced to make a Web connection (Wi-Fi or 3G). The web connection is required mainly because the software must communicate with the Google Speech® ASR to perform speech recognition and to the Arduino Ethernet® for execution of the required operation by the relay shield module. The software sub-menus can be accessed through speech, pressing the button "By speech" or by clicking on the figures presented in this main menu. After pressing the button "By speech", the Android SVOX® TTS software synthesizes a voice message with a set of options (sub-menus) and the user can chose by speech the sub-menu that best suits his/her needs. Each sub-menu allows to perform the operation which better satisfies the user. The operations provided by the software application are switching of the lights (Submenu "Menu Connect and Disconnect Lamps"), switching of the alarm (Submenu "Menu Alarm") and information about indoor and outdoor temperatures ("Menu Temperature"). The software has a mechanism that enables repetition of all issues messages and prompts for all the options that the main-menu offers. When pressing the last button ("Quit"), the application is closed after a confirmation phase (please see Fig 2 that shows the Smartphone display).


Fig. 2. Software main menu

After choosing the desired operation, the user has three buttons in each submenus. For the Submenu "Menu switch on and switch off Lamps" (Fig 3. (a)) and the Submenu "Alarm" (Fig 3. (b)) the first button will turn on the selected device, the second one will turn it off and the third will perform the operations of the previous buttons by speech. In the case of the Submenu "Menu Temperature" (Fig 3. (c)) the first button provides the indoor temperature of the room, the second the outdoor temperature of the room and finally the third makes the same as the third button of the other submenus, respectively. Like in the software main-menu, if the user wants to use speech to execute a certain operation, each sub-menu has a mechanism that repeats all the options if the user wants. The operation report will appear in the area where the WEB symbol is located in the following figures and it will be synthetized through speech by the Android SVOX® TTS software. The button "Go back" ("Voltar") allows going back to the software main menu.

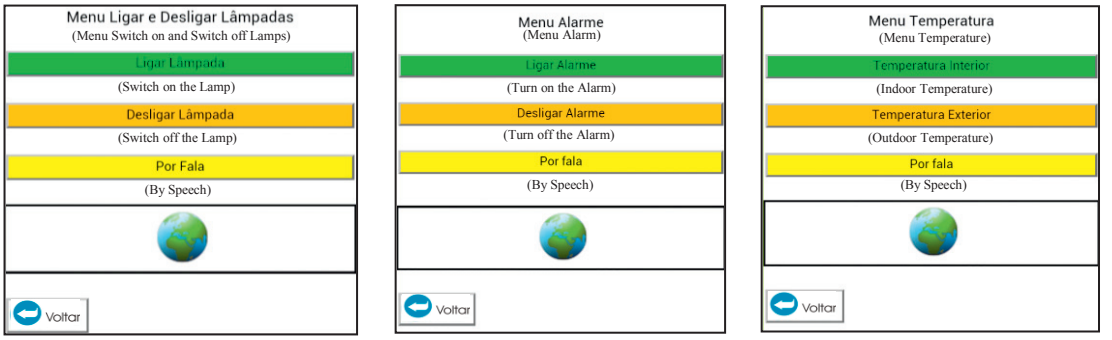


Fig. 3. (a) Submenu "Menu Switch on and Switch off Lamps"; (b) Submenu "Menu Alarm"; (c) Submenu "Menu Temperature"

The following figure is an example of the functionality of the PILSM system, as previously described.

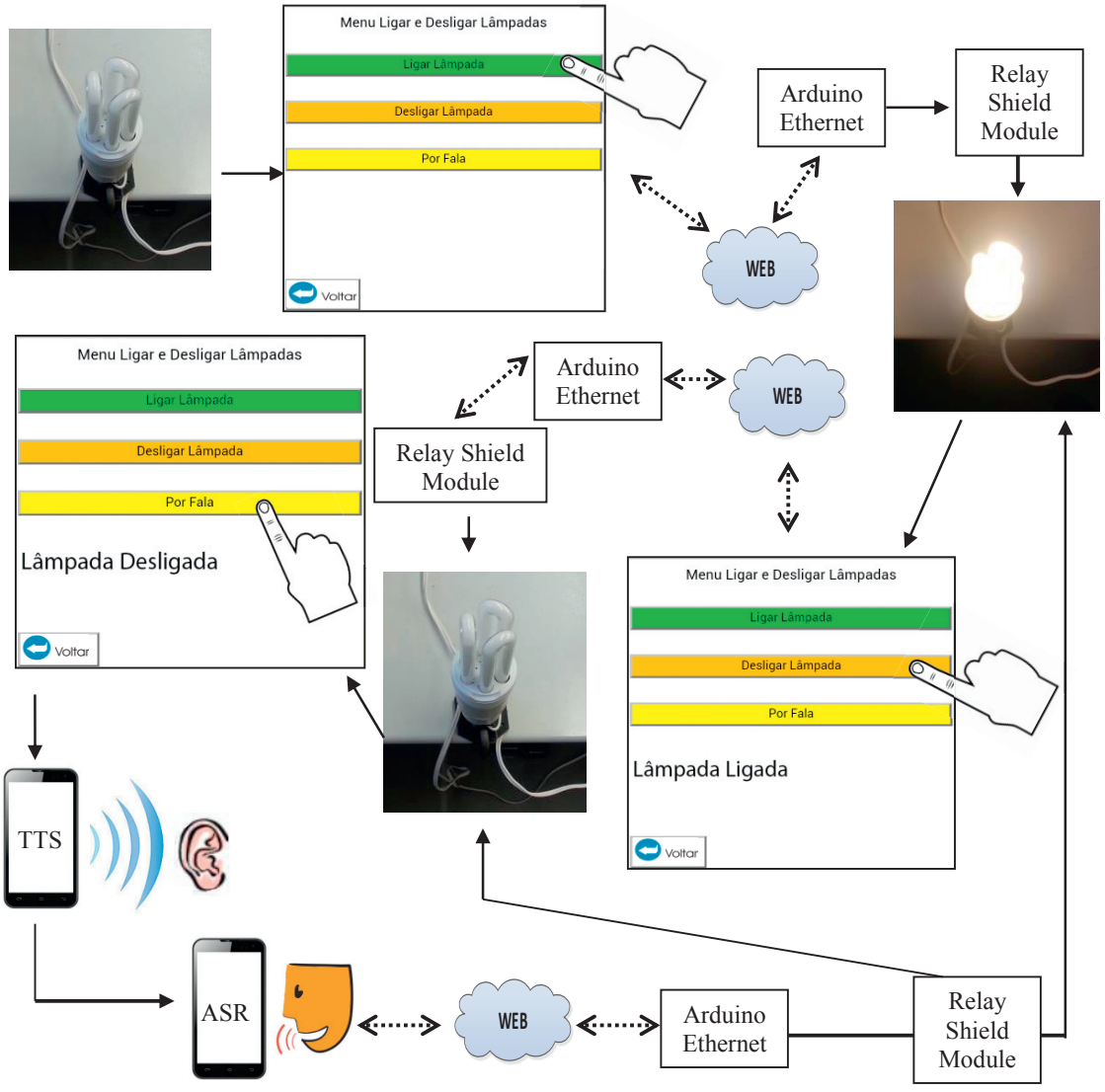


Fig. 4. Example of System functionality to Switch on and Switch off the lights

*3.2. The local control and relay system.*

The local control is an Arduino with Ethernet module as mentioned above, that receives the request operation from PILSM through the Web by a router and controls a relay shield module in order to switch devices off and on; it also collects the indoor and outdoor temperatures, if requested (please see Fig. 5).

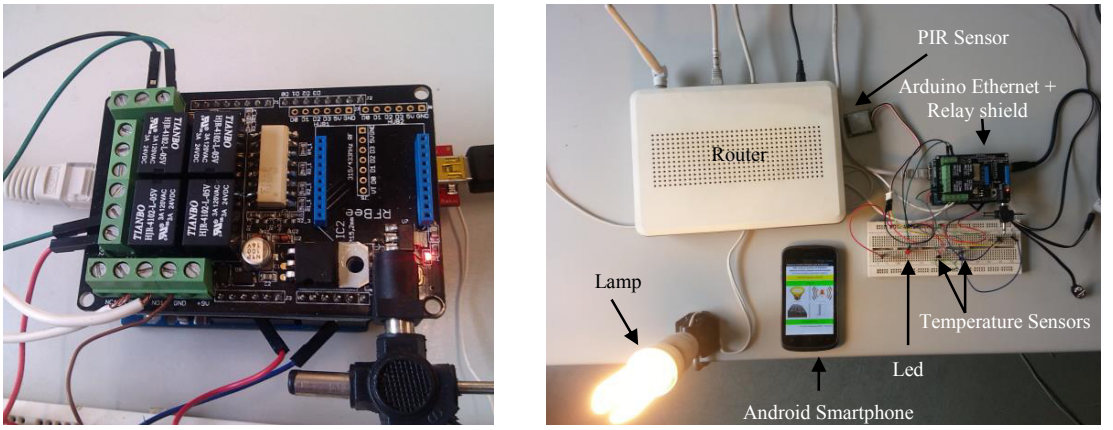


Fig. 5. (a) Arduino with Ethernet connection + Relay Seeedstudio Module; (b) PILSM system

### *3.3. Comparison between State of art Methodologies and PILSM*

"I'm Home" [13] is a service that allows the User to control existing devices at home, namely turn on/off the lights, TV, open/close doors, etc, through a smartphone Windows PDA phone. During this process the smartphone sends information through a local network by IP to the server and this one acts on the selected devices.

The "Home sense" [13] has a similar structure to "I'm Home" but uses a smartphone IOS and requires in addition to a server a laptop to control devices via IP and Zigbee.

The "Aycontrol" (http://aycontrol.com/en) is a software that can run on smartphones like Android and iOS, but it needs a VPN access point and the costs are higher than the platforms mentioned above and than the proposed software PILSM, because “Home sense” only works with devices manufactured by the company that developed it.

The “I’m Home”, the “Home sense” and the proposed PILSM are solutions that can be adapted to the pre-existing structures and devices that there are in a smart home or in an unintelligent home.

It should be noted that all the presented solutions perform the same operations than the solution proposed in this paper. In spite of that the PILSM presents advantages over other platforms because it uses Arduino as a controller (cheaper than local servers and notebooks), it does not require a server to manage and store information and it provides a control device environment by speech which increase the usability and the intelligibility of an interface.

## 4. Conclusions and future perspectives

This Work aimed to create technological solutions that use voice to improve substantially the quality of life of disabled or elderly people in a home environment, especially for those with reduced mobility.

The results obtained have showed that the integration of Smartphones in intelligent houses is completely

feasible and that the created application can be very well accepted by users because it allows to increase the comfort and satisfaction of people in order to interact with the environment wirelessly and seamlessly through speech, providing them a better quality of life because of the ease of use and effectiveness of the system.

Currently there are several challenges that can be taken into account in order to improve and adapt the solution to the constant technological advancement that is observed. However, it is important to examine exactly what is wanted as features of the system, since although the integration of new components in the system is moderately easy, this can significantly increase the complexity of the interface, which may not be desired. This is the first version of this software. In the future, the authors would like to extend this application for other smartphone devices, such as Windows and IOS phones and to integrate other home devices like automatic systems of door control and operation. Finally, we intend to introduce the voice processing required for user identification.

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